

In 1990, the U.S. Geological Survey (USGS), in cooperation with the Albemarle-Pamlico Estuarine Study of the North Carolina Department of Environment, Health, and Natural Resources and the U.S. Army Corps of Engineers, began a 3-year investigation of flows in the Roanoke River and circulation in Albemarle Sound. The objectives of the investigation are to (1) develop a model for computing flow rates in the Roanoke River between Williamston and Albemarle Sound and evaluate flow distributions in the Roanoke River delta, (2) characterize water-quality conditions in Albemarle Sound, and (3) describe the circulation regime of Albemarle Sound, particularly in relation to inflows. This investigation of flows in the Roanoke complements another ongoing USGS study conducted in cooperation with the North Carolina Division of Water Resources and designed to develop a flow model for the Roanoke River between the State Highway 11-42 bridge, near Oak City and Williamston.

Background

Human-induced perturbations to the natural flow regime of tidal rivers generally will result in some degree of change in downstream flow characteristics and estuarine circulation. More importantly, these changes can, and often do, have significant and unexpected effects on estuarine-dependent living resources.

Flows in the lower 137 mi of the Roanoke River (from Roanoke Rapids to Albemarle Sound) have been controlled by a series of reservoirs since about 1952. (Flows in the Roanoke have been affected since the early 1900's by hydropower operations at Roanoke Rapids, although this regulation was much less extensive than it has been since 1952.) Historically, Roanoke River-Albemarle Sound was one of the most productive striped bass spawning areas on the East Coast, ranking third only to Chesapeake Bay and the Hudson River (U.S. Department of the Interior and U.S. Department of Commerce, 1987). However, annual striped bass landings decreased from about 15 to 20 million lbs during the mid-1960's and early 1970's to less than 300,000 lbs during the late 1980's, or a decline of more than 80 percent in 20 years (Manooch and Rulifson, 1989).

There is much uncertainty and debate about the causes for the decline of the Roanoke-Albemarle striped bass stocks, and it has not been demonstrated that changes in the flow regime are solely responsible for the observed declines. However, flow-related processes are undeniably critical at a number of key stages in the early life cycle of striped bass. Flow rates may govern the onset of spawning (Hassler and others, 1981). Transport and mixing processes (1) control the rate of egg transport downstream--eggs should remain suspended and within the channel, not in the flood plain; (2) determine the location at which the eggs hatch--hatching should occur in a region with an adequate food source and moderate flows; (3) affect larval feeding success and mortality--larvae should be transported to historical nursery grounds in the estuarine mixing zone; and (4) affect water quality. Transport and mixing processes also affect the supply of phytoplankton and zooplankton available to larval fish, and appear to be modifying the bathymetry, and thus circulation, in the historical nursery areas in the western part of Albemarle Sound.

In addition to fishery declines, resource managers face increasingly complex water-quality issues in the Roanoke River and Albemarle Sound. Because the Roanoke receives wastewater effluent from several large industrial facilities, including pulp and paper mills, the capacity of the river to assimilate wastes may soon be exceeded (Trevor Clements, North